

# ECoaching across routines to enhance teachers' use of modeling

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## Abstract

The purpose of this research was to determine the impact of eCoaching on two special education teachers' use of modeling strategies across child-led, teacher-led, and mealtime routines. A multiple-probe, single-case design was used to determine the effects of eCoaching on teachers' use of three modeling strategies. Each of the three strategies were methods to model language for children, and they were randomized to three different routines. Results suggest that eCoaching increased teachers' use of modeling strategies and that eCoaching is a socially valid intervention. Considerations for practice and future research are discussed.

*Keywords:* communication, autism, professional development, single-case research

### ECoaching Across Routines to Enhance Teachers' Use of Modeling

The research-to-practice gap, defined as the difference between practices implemented in classrooms and the use of evidence-based practices (EBPs), is a widely recognized problem in special education (Carnine 1997; Cook & Cook, 2013; Cook & Odom, 2013). Although researchers have led efforts to bridge the research-to-practice gap for several decades (e.g., Carnine, 1997; Fuchs, Fuchs, & Burish, 2000; Greenwood, Tapia, Abbott, & Walton, 2003; Odom & Wolery, 2003), facilitating the use of EBPs by teachers on a wide scale remains a significant problem in special education (Klingner, Boardman, & McMaster, 2013). Barriers to widespread implementation of EBPs include policy issues, differences in school and university culture, and differing perspectives on the importance of using research to inform practice (Klingner et al., 2013).

Even when teachers know about EBPs they may not readily transfer that knowledge to the classroom; additional supports are necessary to ensure the use of EBPs in classrooms (Cook & Cook, 2013). Challenges in implementing EBPs are even more pronounced for teachers working with children identified with autism (Mueller & Brewer, 2013; Odom, Cox & Brock, 2013). The number of children identified with autism is greater than ever before (Centers for Disease Control, 2014); yet teachers are not always prepared to utilize EBPs while working with children experiencing this disability (Odom et al., 2013).

One way to address the research-to-practice gap is through professional development (PD; Klingner et al., 2013), which plays a critical role in the preparation and continuation of training for early childhood teachers (Buysse, Winton, & Rous, 2009; National Professional Development Center on Inclusion, 2008). PD is defined as a

program that provides information and training to teachers who are already working in the field (Gomez, Kagan, & Fox, 2015; Snyder, Hemmeter, & McLaughlin, 2011).

Existing evidence suggests traditional PD in the form of one-day trainings is not effective in making long-lasting changes in teacher behavior (Garet, Porter, Desimone, Birman, & Yoon, 2001; Joyce & Showers, 2002). Instead, PD is most effective when it is aligned with existing practices or curricula, and when it is specific, intensive, and sustained over time (Buysse et al., 2009; Garet et al., 2001). As the number of children with special needs, including those with autism, continues to increase in early childhood settings, teachers' knowledge and use of EBPs becomes even more critical in meeting the wide range of children's academic and developmental needs in these settings (Cook & Cook, 2013; Lieberman-Betz, Vail, & Chai, 2013).

### **Bug-In-Ear ECoaching**

Bug-in-ear (BIE) coaching is one method of providing PD that is aligned with current PD recommendations, and has evidence of effectiveness in increasing teachers' use of EBPs (Rock, Gregg, Gable, & Zigmond, 2009; Rock et al., 2013). In BIE coaching, the coach uses a transmitter with a microphone to deliver feedback to the teacher who receives the coach's feedback through a Bluetooth™ earpiece while in the act of teaching. BIE coaching has been used successfully with parents of children exhibiting challenging behavior (Puliafico, Comer, & Albano, 2013), special education pre-service teachers (Cornelius & Nagro, 2014; McAfee, Ruhl, & Lee, 2006), early childhood teachers (Authors, 2014), and with general and special education teachers as part of peer coaching (Scheeler, Congdon, & Stansbery, 2010).

Given recent advances in technology, a new method for delivering feedback, BIE eCoaching, has emerged as an efficient and viable way for teacher educators and researchers to provide real-time feedback to teachers from a distance (Rock et al., 2009; Rock et al., 2013). In BIE eCoaching, the coach delivers feedback from a computer using video conferencing software (e.g., Skype™) to the teacher who receives the feedback through a Bluetooth™ headset while teaching. There is an emerging body of evidence suggesting BIE eCoaching is effective for enhancing special education teachers' use of EBPs (Authors, 2015; under review; Rock, Gregg, Thead, et al., 2009; Scheeler, McKinnon, & Stout, 2012).

For example, Scheeler, McKinnon and Stout (2012) provided feedback to five pre-service elementary special education teachers using webcams and Bluetooth™ technology during direct instruction reading and math lessons. Participants increased their use of three-term contingency trials and maintained their use of the targeted behavior after intervention. Using a mixed-method design, Rock, Gregg, Thead, and colleagues (2009) used Bluetooth™ and Skype to provide feedback during one 30-min reading lesson to 15 teachers enrolled in a graduate-level teacher preparation program. Teachers increased their use of praise statements and evidence-based strategies and students increased their on-task behavior. In addition, teachers reported having positive experiences with the eCoaching technology. In another study of eCoaching, Authors (2015) used Skype and Bluetooth™ to deliver feedback to three pre-service EC teachers on their use of communication strategies during small-group activities (e.g., structured games, sand table play). ECoaching increased all three pre-service teachers' use of the communication strategies. Additionally, Authors (under review) utilized eCoaching with

four new teachers targeting their communication practices with children at risk for autism. Results suggest eCoaching increased their use of naturalistic communication strategies. Collectively, these findings indicate that BIE eCoaching can improve teachers' use of EBPs in real-world classrooms.

### **Generalization of Skills across Routines**

Although teachers acquire new skills during eCoaching interventions within a given routine (e.g., small-group activities) and generally maintain their use of newly-acquired skills within those same routines, our previous research (Authors, 2015; under review) suggests there is variability in teachers' generalization of new skills to other classroom routines. For example, Authors (2015) examined the use of naturalistic communication strategies by three early childhood pre-service teachers when they received eCoaching during small-group activities that were child-led (e.g., block play) and teacher-led (e.g., a structured bingo game). All participants increased their use of the communication strategies during intervention sessions and sustained their rates of use above baseline during maintenance sessions. Generalization data were collected in settings that differed from the one in which the pre-service teachers received feedback. The generalization data were variable across participants and only two data points were collected. Another interesting finding was one pre-service teacher elected to use a large-group, teacher-led routine (i.e., circle time) for generalization; her data indicated that she did not generalize her use of communication strategies to this routine. Given that the generalization data were variable, it is difficult to determine if the lack of generalization was due to teacher factors, differences in routines, or the ineffectiveness of the intervention in promoting teachers' generalization of skills.

In another study examining BIE eCoaching with in-service teachers, Authors (under review) used a single-case, multiple-probe design to examine the effects of BIE eCoaching on four first-year early childhood special education teachers' use of naturalistic communication strategies. All four teachers increased their use of the communication strategies during intervention and maintained their use of strategies during maintenance. Researchers collected data in five generalization sessions for each participant in a variety of routines including meals, free play, and large-group activities (i.e., circle time). One of the four teachers consistently generalized her use of the strategies to new routines, including large-group, teacher-led routines, whereas the other three teachers had difficulty using the strategies in new routines, regardless of the routine -type. These findings suggest that some teachers may need additional supports to generalize newly-learned skills to different routines and that generalization to different routines is variable (Authors, 2015; under review).

Given teachers' variability in using newly-learned skills across routines (Authors, 2015; under review), additional research is needed to examine the use of BIE eCoaching to promote teachers' use of skills across routines. To our knowledge, only one study has examined the use of BIE eCoaching with practicing early childhood teachers (Authors, under review). In addition, all eCoaching in that study took place during small-group activities limiting our understanding of eCoaching in other routines in early childhood classrooms. The purpose of this study, therefore, was to examine the impact of BIE eCoaching on two first-year early childhood teachers' use of modeling, a naturalistic communication strategy that includes the three distinct techniques of (a) self-talk, (b)



parallel-talk, and (c) expansions during three different classroom routines (i.e., child-led, teacher-led, mealtime). Our research questions included:

1. Is there a functional relation between eCoaching and teachers' use of modeling strategies (self-talk, parallel-talk, and expansions) across routines?

## **Methods**

### **Participants**

Two special education teachers, Noelle and Jordan (pseudonyms), participated in the study. Both were participants in one of our BIE eCoaching studies implemented during the previous school year when they were pre-service teachers (Authors, 2015).

The rationale for recruiting these participants was due to their new role (teacher as opposed to student teacher) and to provide them supports across routines as their generalization data in a previous study were limited and variable (Authors, 2015).

Additionally, we focused on different naturalistic communication strategies that aligned with the needs of the students in both of their current classrooms. Before the research began, Institutional Review Board approval was obtained by the first author's university, as well as the school districts in which the teachers worked. Although the intention was for all three of the participants in the original study to participate, one school district did not provide approval for the research to occur, so we were only able to recruit two of the three participants.

Noelle was a 23-year-old Caucasian female whose highest level of education was a Bachelor's degree. Noelle was certified to teach children with and without disabilities between the ages of birth through five. Noelle taught in a self-contained, state-licensed school in the mid-Atlantic region of the United States. At the time of the study, the school

served 14 children 5 - 22 years of age with autism, intellectual disabilities, and speech-language impairments. The school's programs emphasized intensive and individualized instruction using the principles of applied behavior analysis to provide academic and functional skill instruction. Each student was assigned a teaching team that consisted of a licensed special education teacher, behavior analyst, and one or more instructors.

Noelle's teaching team provided instruction to four students using the instructional groupings of one-to-one or two-to-one dyad training. Her students were all 6 - 7 years of age and all were diagnosed with autism.

Jordan was a 24-year-old Caucasian female whose highest level of education was a Bachelor's degree. Jordan was certified to teach children with and without disabilities between the ages of birth through five. Jordan taught in an inclusive public preschool classroom in the mid-Atlantic region of the United States. Jordan's school provided instruction to over 400 children with and without disabilities between pre-kindergarten and fifth grades. At the time of the study, Jordan had 10 children 4 - 5 years of age in her classroom; six were typically developing and four were diagnosed with autism.

### **Single-Case Research Design**

A multiple-baseline, multiple-probe across routines design was used to examine the efficacy of BIE eCoaching on the teachers' implementation of targeted communication strategies. The research design met quality standards with reservations for multiple-probe single-case research as outlined by What Works Clearinghouse because one of our participants had four baseline data points, instead of five, during one routine (Kratochwill et al., 2010). Each participant had three opportunities to demonstrate an effect, which was replicated across the two special education teachers. Classroom

routines included child-led, teacher-led, and mealtime routines. These were randomly paired with communication strategies so that each teacher received a different pairing of routines with strategies (see Table 1). During child-led routines the teacher interacted with the child one-on-one doing an activity the child chose, whereas during teacher-led routines the teacher initiated an activity with a small group of two to four children from a specific lesson plan.

To strengthen the scientific rigor of the research, two forms of randomization were included in the research design (Kratochwill & Levin, 2010). First, we randomly assigned the order of the routines during which the teachers were provided with eCoaching. Second, during the baseline phase, we randomly determined the start point for routines two and three within a two-day window either 6 - 7 sessions after the previous phase (Noelle) or 5 - 6 sessions after the previous phase (Jordan). The shorter number of intervention sessions for Jordan were necessary to ensure that all data collection concluded prior to the end of the school year.

### **BIE eCoaching Intervention**

The intervention for this study was BIE eCoaching provided by the first author (hereafter referred to as the coach) to the teachers. Intervention sessions lasted a total of 6 min at the beginning of a teacher-led, child-led, or mealtime routine. Teacher-led routines were routines in which the teacher had preplanned an activity with specific procedures such as a matching memory game. Child-led routines were routines in which the teacher followed the child's lead on a specific choice they made such as playing with blocks. Mealtime routines were routines such as snack or lunchtime. During each of these routines, the coach used the first minute to acclimate herself to the activity and provided

no coaching during this time. Then, prompts were provided throughout the remaining 5 min to support the teachers' use of the communication strategies during the activity. Prompts were designed to be provided at a rate of 1 per min; however, there were instances in which it was not possible to provide a prompt (due to a behavioral situation or a need to reengage a child in an activity). During these times, it was not possible to provide the number of designed prompts and it was also not possible for educators to utilize strategies as their attention may have been directed at managing a challenging behavior or reengaging a child in an activity. The purpose of the prompts was to highlight an opportunity for the teachers to embed the communication strategies within the activity that was being observed. For example, the coach might say to a teacher participant, "Can you describe what you are doing by saying I am stirring." After providing a prompt, the coach observed the teacher's interactions with the children and then provided corrective feedback if the strategy was used incorrectly or affirmative feedback if the strategy was used correctly. Corrective feedback gave the teacher guidance on how to accurately utilize the strategy (e.g., "The next time you place a block on the tower, say I am building with blocks."). Additionally, if the teacher spontaneously used the strategy with the children without being prompted, the coach would provide affirmative feedback to the teachers, praising their correct use of the strategy (e.g., "Nice job using self-talk").

The coach only provided feedback to the teachers on one strategy per routine, which was determined before intervention began based on the randomization schedule. Specifically, one of the three modeling strategies (parallel talk, self talk, or expansions) were paired with one routine (child-led, teacher-led, or mealtime) based upon

randomization as all three of these strategies are forms of modeling and thus have the capacity to enhance children's communication despite their current level of communication. For example, during mealtimes, the coach provided Noelle with feedback on using self-talk, but not expansions or parallel-talk (see Table 1). During no other routine (i.e., teacher-led, child-led) was feedback provided on Noelle's use of self-talk. Teachers received between five and seven BIE eCoaching intervention sessions and between zero and two BIE eCoaching intervention probe sessions for each of the three routines (see Table 1). During teacher-led routines, the coach provided Jordan with feedback on using parallel-talk, but not expansions or self-talk (see Table 1). During no other routine was Jordan provided feedback to use parallel-talk. Table 1 describes which communication strategies were coached during which routines and how many sessions of coaching each participant received. These decisions were based upon randomization to strengthen the internal validity of this study.

**Materials.** Teachers selected and used materials from their own classrooms during all sessions. Examples included letter matching cards, art materials, and books for teacher-led routines; trampoline, hula-hoops, and game pieces for child-led routines; and food, drinks, iPads, and choice boards for mealtime routines. Additionally, BIE technology and video-recording equipment/software were used for the purposes of data collection.

## **Measures**

**Coaching feedback.** The independent variable was the provision of BIE eCoaching to the two teachers. Sessions were audio recorded and coded by trained graduate students. Data were coded for the frequency with which prompts, corrective

feedback, and affirmative feedback were provided to the teachers, as well as for the type of communication strategy targeted during feedback.

**Communication strategies.** Teachers' correct use of the targeted modeling strategy (expansions, parallel-talk, self-talk) was the dependent variable. Table 2 provides the operational definition for each strategy, an example of it in practice, and references for other research studies documenting the strategies' efficacy (Author, 2013).

**Social validity and demographic questionnaire.** At the end of the study, each teacher completed an electronic survey consisting of three sections. The first section included 10 demographic questions related to the teachers' background (e.g., What was the degree for your highest level of education?) and the make-up of their classrooms (e.g., How many children were in your classroom this year?). The second section included 16 Likert-scale statements measuring teachers' experiences with BIE eCoaching (e.g., Receiving feedback via BIE was helpful in changing my communication practices with young children), their use of the communication strategies across routines (e.g., I currently use the three modeling strategies during mealtimes), their confidence in continuing to use the strategies independently (e.g., I am confident that I will continue to use expansions without receiving BIE feedback), and their perceptions of the efficacy of the strategies in promoting children's communication (e.g., When I used the modeling strategies, the children communicated more regularly). Teachers rated these Likert-scale statements using a five-point scale that ranged from strongly agree to strongly disagree. The final section of the survey included eight open-ended questions regarding their experiences with BIE eCoaching (e.g., What did you enjoy the least about the BIE experience?) and their perceptions of the use of the strategies across classroom routines

(e.g., Were any of the three classroom routines easier or more difficult to embed the modeling strategies in than the others?).

## **Procedures**

During baseline, maintenance and generalization phases, the teachers video-recorded each session using the camera feature on the iPad. Videos were shared with researchers by manually downloading each video or using onedrive to share videos. During intervention phases, the researchers utilized eCamm Call Recorder or Evaer to record sessions. During all phases of the study, the first 6 min of each video were coded for both the dependent and independent variables.

**Baseline.** The baseline phase of the research captured teachers' business-as-usual practices prior to receiving BIE eCoaching. No training was provided to the teachers on the three modeling strategies during baseline; however, when the teachers were in their pre-service preparation program (about one year prior to this research), they received instruction on the communication strategies as a component of their coursework.

Throughout the baseline phase, teachers video-recorded themselves for at least four 6-min sessions in each routine (i.e., teacher-led, child-led, mealtimes) and then electronically sent the videos to the first author or the first author manually downloaded them. For routines that were targeted during Intervention Two and Three, baseline probe data were collected immediately prior to the start of another intervention phase to demonstrate single-case standards for a multiple-probe design (Kratochwill et al., 2010).

**Intervention One, Two, and Three.** Each intervention phase included coaching on one modeling strategy within one routine (see Table 1). Upon transitioning from one intervention phase to the next (e.g., from Intervention One to Intervention Two), probe

BIE eCoaching sessions were conducted at least once in each subsequent intervention phase. Procedures for probe sessions were identical to intervention sessions (coaching was provided providing prompts and feedback). This resulted in two intervention probe BIE eCoaching sessions for the routine targeted in Intervention One and one probe session for the routine targeted in Intervention Two.

**Maintenance.** At the conclusion of Intervention Three, BIE eCoaching ceased and the teachers collected five 6-min videos for each of the three routines. The first author manually uploaded the videos or the videos were electronically shared using onedrive upon completion of maintenance. No interactions occurred between the coach and the teachers during the maintenance phase, except to communicate progress being made recording the 15 maintenance videos. Noelle collected the maintenance videos between 11 and 15 days after Intervention Three, and Jordan collected the maintenance videos between 2 and 22 days after Intervention Three.

**Generalization.** Generalization data were collected by coding the videos and coded strategies during sessions when the strategies were not coached (two routines). In this manner, we were able to observe whether or not the teachers were using non-targeted strategies during other classroom routines. For example, although Jordan received no coaching to use parallel-talk during mealtimes or child-led routines, Jordan's correct spontaneous use of parallel-talk within these routines was coded to determine whether her implementation of these strategies generalized to the other routines (e.g., teacher-led and mealtime routines). Using this method of data collection, we were able to document the teachers' typical use of strategies across all of the research phases so that generalization could be evaluated.



### **Reliability and Fidelity of Implementation**

Inter-observer agreement (IOA) was calculated using the total agreement method (Kennedy, 2005) for a random 20% of videos across all routines, research phases, and participants. Total agreement was calculated for all dependent and independent variables by taking the frequencies of each behavior from each data coder and then dividing the total number of agreements by the total number of agreements plus disagreements and multiplying by 100. Mean IOA was 100% for teachers' prompted use of strategies, and 91.55% for teachers' spontaneous use of strategies.

Data on the independent variables were also used to determine fidelity of implementation by answering a series of yes/no questions for these videos based upon a fidelity checklist. The fidelity checklist included items regarding whether feedback was provided on the targeted communication strategy for the routine and no other communication strategies, as well as whether the coaches followed up on prompts with either corrective or affirmative feedback as applicable. The number of yes responses were divided by the total number of response options and multiplied by 100. Implementation fidelity was 100% for sessions conducted with Noelle and 91.1% for sessions conducted with Jordan. Implementation fidelity by routine was 91.7% for mealtime, 95% for teacher-led, and 100% for child-led routines.

### **Data Analysis**

The primary method of data analysis was the visual analysis of graphed data. Using the procedures outlined by Kratochwill and colleagues (2010) graphed data were examined for the following six components: level, trend, variability, immediacy of effect, overlap of data, and consistency of data patterns across research phases. Then, using an

online effect-size calculator (Vannest, Parker, & Gonen, 2011), teachers' data were entered for each routine's research phase to identify effect sizes (Tau-U) for each routine as well as for omnibus effect sizes across activities for each teacher.

In addition, a graduate student at the first author's institution, who was kept naive to the progression of the research and the outcomes, completed masked visual analysis of the data. The purpose of masked visual analysis is to control for Type I error (concluding an effect occurred when it did not) using a visual technique (Ferron & Jones, 2006).

Following procedures outlined by Ferron and Jones (2006), the graduate student reviewed individual graphs of each teacher's use of the targeted communication strategies for each of the three routines. Graphs included baseline and intervention phases only with the time-lags between probe sessions removed as the time-lags would have made the order of intervention apparent. Upon review of the graphs, the student indicated the order in which she perceived each routine was coached. Following recommendations for masked visual analysis, we asked the student to review the graphs until she was able to determine the correct order of intervention phases.

The correct order of intervention was provided on the first attempt for Noelle and the fourth attempt for Jordan. These numbers were then divided by the total possible assignments available from the randomization of routine order and randomization of the length of intervention phases. More specifically, there were three routines to select from for Intervention One, two to select from for Intervention Two, and one to select from for Intervention Three. Further, the number of intervention sessions possible for each of the three intervention phases was two. Thus, the number of possible assignments was 24 ( $= 3 \times 2 \times 1 \times 2 \times 2$ ).

## Results

Results are organized by participants and routines. Graphs for each participant are presented in Figures 1 and 2.

### Noelle Mealttime Routine

Based on randomization, Noelle was coached in using self-talk during mealttime. During baseline, although Noelle used a variable number of total modeling strategies (range = 2 - 10; mean = 5.38), she used self-talk 1 time during 1 session prior to the start of intervention. Once intervention began, Noelle's data demonstrate an immediate effect and an increase in level in her use of self-talk; however, her self-talk data were variable with two intervention data points overlapping with baseline data. She received a range of 0 - 3 prompts during the 6-min sessions with mean of .63, and she appropriately responded to 100% of prompts. Her use of self-talk was variable (1 - 5) with an average of 3 uses of self-talk per session. Her Tau-U calculation of .86 suggests intervention had a strong effect on Noelle's use of self-talk during mealtimes. During intervention her use of total modeling strategies ranged from 7 - 15 with an average of 10.75. Noelle's maintenance data were variable. During maintenance, she used a range of 0 - 3 self-talk strategies with a mean of 1.4. Her total use of modeling strategies during maintenance ranged from 9 - 17 with a mean of 14.

### Noelle Teacher-led Routine

Based on her randomization assignment, Noelle was coached in using expansions during teacher-led routines. During baseline, Noelle used expansions 0 - 3 times with a mean of 1.13, and 1 - 7 total modeling strategies with an average of 3.38. Once intervention began, her data suggest an immediate effect and increase in level with an

accelerating trend. Noelle received a range of 0 - 2 prompts with a mean of .86. She appropriately responded to 70% of prompts. Data were variable with a range of 2 - 7 and a mean of 4.29 uses of expansions. Her Tau-U calculation of .84 suggests intervention had a strong effect on Noelle's use of expansions during teacher-led routines. During intervention her total use of total modeling strategies ranged from 6 - 15 with a mean of 9.43. Noelle maintained her use of expansions (range = 6 - 8; mean = 7.8). Her use of total modeling strategies ranged from 8 - 13, and she used an average of 10.4 total modeling strategies per maintenance session.

### **Noelle Child-led Routine**

Randomization resulted in Noelle receiving coaching to use parallel-talk during child-led routines. During baseline, Noelle used parallel-talk between 3 - 13 times with a mean of 6.33, and a range of 6 - 16 total modeling strategies with a mean of 10. Once intervention began, her data were variable (range = 2 - 12); however, her data demonstrate an increase in level as she used an average of 8.57 parallel-talk strategies. Noelle received a range of 0 - 2 prompts per session with a mean of .86 prompts. She appropriately responded to 75% of prompts. Her Tau-U calculation of .33 suggests intervention had no effect on Noelle's use of parallel-talk during child-led routines. Her total use of modeling strategies during intervention ranged from 4 - 19 with a mean of 11.43 uses. She maintained use of parallel-talk with a range of 2 - 11 uses and a mean of 7.4. Her total use of modeling strategies during maintenance ranged from 6 - 19, and she used an average of 13.8 total modeling strategies per session.

### **Noelle's Summary of Results**

Although Noelle's data were variable for two of the three routines, her data suggest two demonstrations of an effect due to the increase in level; however, there was one non-demonstration of an effect. Her overall Tau-U effect size was .64 suggesting a moderate effect; however, this is due to stronger effects in two routines (teacher-led and mealtime) and no effect in one routine (child-led). Masked visual analysis resulted in a  $p$  value of .04 suggesting significant results of the intervention – a finding misaligned with our analysis of the data. Her maintenance data suggest that she maintained increased use of self-talk, parallel-talk, expansions, and total modeling strategies when compared to baseline. Noelle's generalization data suggest she increased her use of expansions and parallel-talk in mealtime routines as well as her total average use of those strategies during mealtime (see Table 3). She increased her use of self-talk in teacher-led routines. She also increased her use of self-talk, expansions, and total strategies during child-led routines.

### **Jordan Teacher-Led Routines**

Due to her randomization assignment, Jordan was coached in using parallel-talk during teacher-led routines. During baseline Jordan used a range of 0 - 4 parallel-talk strategies with a mean of 1.5, and she used a range of 2 - 6 total modeling strategies with an average of 4.5. Once intervention began her data demonstrated an immediate effect and an increase in level. She received a range of 1 - 3 prompts with a mean of 2.29. She appropriately responded to 95.38% of prompts. During intervention she used a range of 3 - 12 parallel-talk strategies with a mean of 6.43. Her Tau-U calculation of .75 suggests intervention had a moderate effect. Her range of total modeling strategies was 5 - 15 with

a mean of 10.14. During maintenance, Jordan used a range of 0 - 1 parallel-talk strategies with a mean of .6. She used a range of 1 - 5 total modeling strategies with an average of 2.6 per session.

### **Jordan Child-led Routines**

Randomization resulted in Jordan being coached to use self-talk during child-led routines. During baseline Jordan used a range of 0 - 1 and a mean of .29 self-talk strategies. Once intervention began Jordan's data demonstrate an immediate effect and increase in level. Her total use of modeling strategies ranged from 2 - 7 with a mean of 3.43. During intervention Jordan received a range of 0 - 3 prompts with a mean of .83, and she appropriately responded to 88.89% of prompts. Jordan used a range of 3 - 7 self-talk strategies with a mean of 4.67. Her Tau-U calculation of 1.00 suggests intervention had a strong effect on her use of self-talk within child-led routines. Her range of total modeling strategies was 9 - 17 with a mean of 11.67. During maintenance she used a range of 0 - 2 self-talk strategies with an average of .6. Her total use of modeling strategies, during maintenance, ranged from 2 - 6 with an average of 4.

### **Jordan Mealtime Routine**

Based on randomization, Jordan was coached in using expansions during mealtime routines. During baseline, Jordan used a range of 0 - 9 expansions with a mean of 1.89, and a range of 0 - 9 total modeling strategies with a mean of 3.22. Once intervention began, Jordan's data demonstrated an immediate effect of intervention and increase in level. She received a range of 0 - 2 prompts with a mean of 1 prompt per session, and she appropriately responded to 60% of prompts. During intervention, Jordan used a range of 4 - 7 and a mean of 5.33 expansions. Her total use of modeling strategies

ranged from 4 - 9 with a mean of 6.5. Her Tau-U calculation of .78 suggests intervention had a moderate effect on Jordan's use of expansions during mealtime routines. Jordan maintained use of expansions with a range of 2 - 5 expansions and a mean of 3.8. During maintenance she used a range of 2 - 6 total modeling strategies and an average of 4.4.

### **Jordan's Summary of Results**

Although Jordan's baseline data were variable for all three routines Jordan's intervention data suggest a strong effect due to three demonstrations of an effect across three routines as evidenced by an increase in level at each time point. Likewise, Jordan's weighted omnibus Tau-U calculation was .85 suggesting intervention had a strong effect on her use of modeling strategies across routines. Data suggest the intervention had a strong effect on Jordan's use of self-talk during child-led routines and a moderate effect on her use of expansions during mealtime routines as well as parallel-talk during teacher-led routines. Masked visual analysis resulted in a *p* value of .17 suggesting insignificant results of the intervention – this finding was again contrary to the results obtained from visual analysis and effect size calculations. Additionally when comparing her maintenance to her baseline data, she demonstrated increased use of expansions and self-talk, and total modeling strategies within child-led and mealtime routines. Jordan's generalization data suggest she increased her use of self-talk, parallel-talk, and total modeling strategies during mealtime routines as well as her use of self-talk during teacher-led routines (see Table 4). She also increased her use of parallel-talk and total modeling strategies during child-led routines (see Table 4).

**Social Validity**

Jordan and Noelle strongly agreed or agreed that eCoaching was helpful, and that they currently use, and will continue to use, all three modeling strategies across routines. They indicated they would recommend eCoaching to other teachers, and identified that the technology was helpful and manageable. Jordan agreed that eCoaching improved children's communication while Noelle was neutral. Jordan and Noelle explained that eCoaching was beneficial because it was immediate and they received praise statements in real time. They expressed some challenges related to the technology that were specific to setting up the iPad and the occasions where there were internet connection issues. They indicated that eCoaching improved the quality of their teaching because the modeling strategies became a part of their conversation with children; Noelle expressed that self-talk was especially effective in getting the children to interact more with her, using increased eye gaze and using appropriate verbal responses. Jordan said that as a result of using the modeling strategies the children in her classroom started explaining what they were doing in their play, and she saw an increase in their vocabulary. Jordan indicated that it was easier to embed modeling strategies in child-led and teacher-led routines than during mealtime because there was so much more to talk about during child-led and teacher-led routines. Noelle explained mealtime was more difficult than the other routines due to more children being a part of that routine. Jordan and Noelle reported that they enjoyed eCoaching and learning more about other communication strategies within their daily routines.



## **Discussion**

The purpose of this research was to determine whether a functional relation exists between eCoaching and teachers' use of three modeling strategies across routines. This study adds to the literature by supporting the research base, which has suggested that eCoaching has the potential to increase teachers' use of EBPs (Authors, 2015; under review). Although we met criteria for single-case design criteria with three demonstrations of an effect for Jordan, we were unable to see an effect across three routines for Noelle with only two demonstrations of an effect. Additionally, this manuscript provides insights regarding eCoaching in early childhood special education settings, and training for generalization, both of which are novel to this line of research. Finally this study provides guidance related to future research in this area.

### **ECoaching in Early Childhood Settings**

This research supports previous findings suggesting eCoaching has the potential to increase the use of EBPs by teachers who are working in early childhood special education settings with children identified or at-risk for autism (Authors, under review). Jordan did increase her use of modeling strategies within three routines, whereas Noelle increased her use in two of the three routines. However, it is important to note, that there was no effect in Noelle's use of parallel-talk within child-led routines.

Additionally, our social validity data align with previous findings (Authors, 2015; under review). Noelle and Jordan indicated that eCoaching was effective in increasing their use of modeling strategies and improving communicative and social outcomes of the child participants. For example, educators indicated that the students began using more appropriate expressive communication, were answering questions more appropriately,

and used more eye contact. They also explained that the eCoaching intervention was feasible and manageable. These findings align with previous research suggesting eCoaching in early childhood special education settings is considered a socially valid intervention.

### **Lessons Regarding Generalization Training and Future Directions**

ECoaching research provides a limited amount of information regarding generalization (Authors, 2015; under review). Therefore, in this study our hope was that by providing feedback across routines related to various types of modeling strategies that participants would generalize previously-coached modeling strategies across routines. Our data suggest that we need to program for generalization (Scheeler, Bruno, Grubb, & Seavey, 2009; Stokes & Baer, 1977) by coaching a specific single strategy across routines, as even when the strategies coached are similar, our data suggest variable generalization results (see Table 3). Therefore, future research should be focused on coaching specific strategies across various routines to support teachers in consistently generalizing EBPs to new contexts.

Other factors to consider are the number of strategies simultaneously introduced, the coaching model, and length of feedback in early childhood settings and how these might influence teacher generalization. For example, Authors (2015) introduced and coached four strategies at one time, whereas Authors (under review) coached two strategies. Although the generalization data in Authors (2015) were more stable, fewer generalization data points were collected and more strategy options were provided, making it difficult to draw conclusions related to the number of strategies that should be coached at one time. As we begin to consider barriers and supports to promote

generalization of EBP, the number of EBPs introduced at one time is something to consider. It is also critical to tailor communication strategies not only to the needs of the child but also to the teacher's use of current practices. Our goal in this study was to utilize strategies that would enhance the communication of children experiencing various communication needs (i.e., non-verbal, minimal expressive communication) and to use randomization to determine which strategies to coach during specific routines to increase internal validity; however, given our findings, we would recommend that these decisions be based on current teacher use of the strategies. In addition, conducting an extended baseline or pre-baseline phase is a method researchers might consider to ameliorate the challenges associated with those we experienced related to variable baseline data.

Furthermore, the feedback procedures are an additional aspect that have differed across early childhood BIE research studies. Whereas some BIE coaching research has paired BIE feedback with other forms of PD such as an introduction to strategies (Authors, 2014; Authors, 2015) and practice opportunities (Authors, 2014), other early childhood research has not included an introduction to strategies or practice, but rather began coaching right away by providing feedback (Authors, under review). In future studies, researchers might manipulate these variables to determine whether some type of priming (e.g., instruction on the EBP to be coached) increases the effectiveness of the coaching intervention.

The length of the feedback sessions are an additional component that has also differed across early childhood BIE studies. Whereas some BIE coaching sessions have been 10 min in length (Authors, 2015) others have been 6 min (Authors, under review). The length of feedback sessions, presents an additional point of consideration related to

the ceiling of target strategy use. Because of short segments of feedback it is important to consider how much of an increase one can expect in a target behavior within the short observation window. For example, though a small improvement of three behaviors may seem trivial, given that the coaching sessions were only 6 min in length, extrapolated, this would mean teachers would use on average 30 more behaviors per hour – a substantial increase in the learning opportunities provided to children.

The number of strategies coached, coaching procedures, as well as feedback length are important procedural considerations that must be contemplated when identifying a model that is most effective not only in increasing teacher use of EBPs but also sustaining their use of these practices through generalization.

### **Limitations**

Although one participant's data illustrate three demonstrations of an effect, there are limitations to this research. Due to technical difficulties, one of Jordan's baseline sessions was missing and one of her intervention sessions did not have audio. This prohibited us from coding these data. Although the coach was present during intervention, the coach was not present during baseline and maintenance phases, which may have impacted teacher interactions with the child participants. Additionally, the two teacher participants, although not coached in these specific communication strategies or coached across routines, were familiar with similar coaching and feedback procedures due to participating in a previous study, which could be a threat to the internal validity of this study. Finally, collecting a probe at the start of intervention in each phase would have strengthened the research design.

Masked visual analysis provides an avenue for learning about the effect of an intervention, but it also is associated with challenges. For example, in multiple-probe designs all data points must be connected in order to securely mask the order of intervention, but this in turn proves challenging for multiple-probe studies that have only one or two data points extra in subsequent baseline phases. This means unless there is a large immediate effect on the first or second intervention session, it is extremely challenging to identify the order in which intervention occurred. For example, we have utilized Masked Visual Analysis in former multiple probe designs where baseline data were zero-celerating with no instances of the target behavior, and therefore, there was an extremely visible immediate effect (Authors, under review). Whereas masked visual analysis aligned with our data analysis in the former study, this was a challenge for the present study as the functional relation was in some instances more gradual or not as strong. Thus, our masked visual analysis results may not be as strong as they could have been had we used a multiple baseline design. Consequently, for Masked Visual Analysis, multiple probe designs might be a topic for future methodological consideration.

### **Implications for Research and Practice**

These data like data from our previous studies (Authors, 2015; under review) suggest that eCoaching is both manageable and effective in increasing early childhood teachers' use of EBPs. This is an important consideration for both practice and research. While PD is a necessity, it frequently is thought of as an expense and does not often result in change (Garet et al., 2001; Joyce & Showers, 2002). Therefore, as higher education faculty and school administrators consider avenues to develop sustainable change, BIE eCoaching may be an inexpensive, unobtrusive, and effective way to

provide PD in early childhood settings. This is particularly important for teachers working with populations of children whose needs they are not always prepared to meet, such as autism.

These results are important for researchers to consider as well. While the results suggest the effectiveness of eCoaching, it is important to continue to investigate the maintenance as well as generalization of EBPs. Although our goal in this research was to address generalization by providing feedback across routines, results suggest very little to no change in generalization data meaning it might be necessary to coach one specific strategy across routines. Additionally, programming for both maintenance and generalization by embedding a fading phase might be an effective approach decrease variability in maintenance and generalization.

### **Conclusion**

As we continue to learn more about effective PD, it is important to consider the impact of alternative forms of PD that result in teacher change. One-day trainings are known to be less effective than ongoing training methods, like eCoaching, that are embedded within a teacher's daily practice (Garet et al., 2001; Joyce & Showers, 2002). This research provides an example of utilizing complex single-case design to bridge the research-to-practice gap for children with autism by increasing teachers' use of EBPs with this population.

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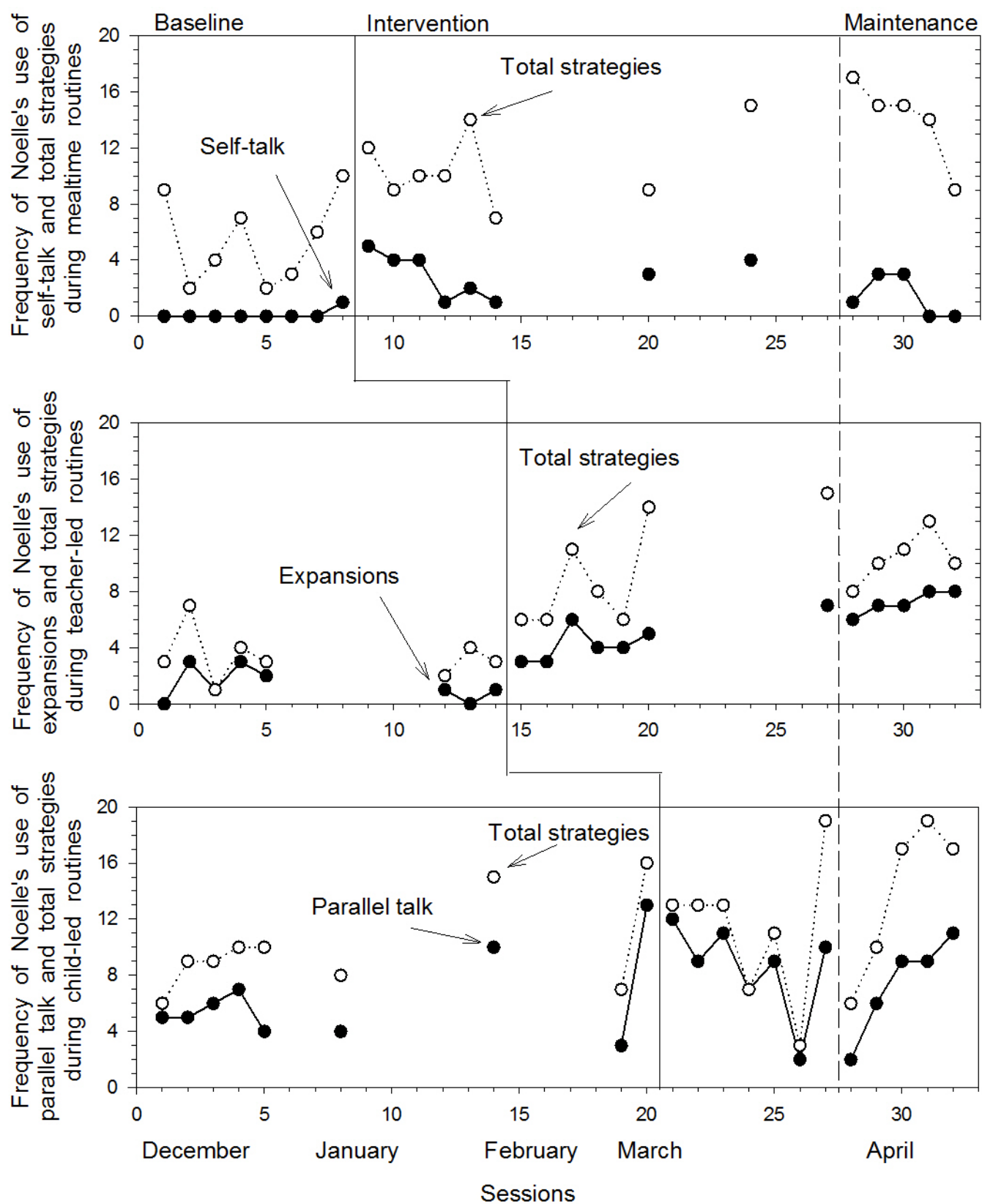


Figure 1. Noelle's use of targeted communication strategies across three classroom routines.

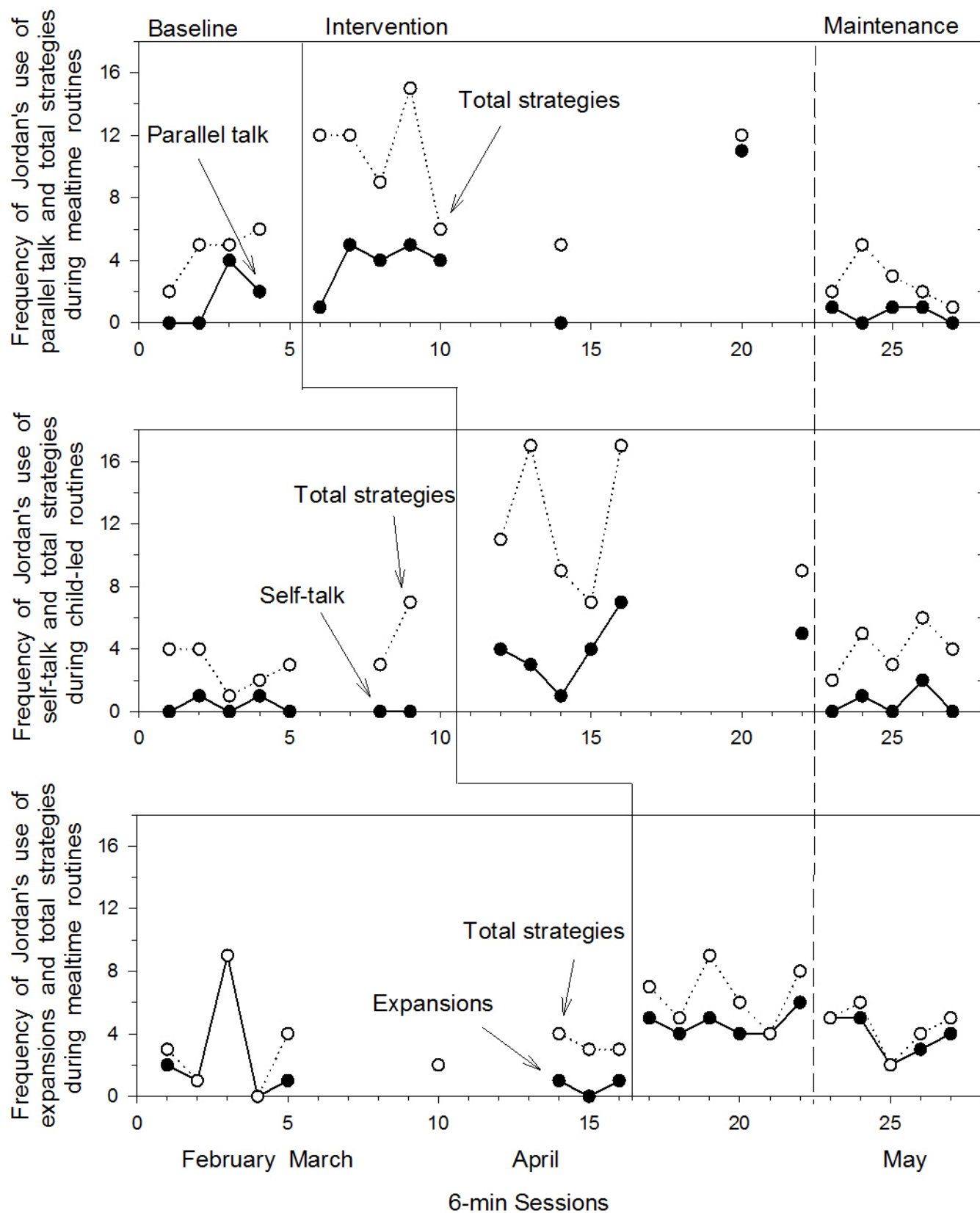


Figure 2. Jordan's use of targeted communication strategies across three classroom routines.